REPORT

Petroleum, Geothermal and Major Hazard Facilities

ANNUAL REPORT 2020/21

November 2021

New Zealand Government

WORKSAFE
Mahi Haumaru Aotearoa

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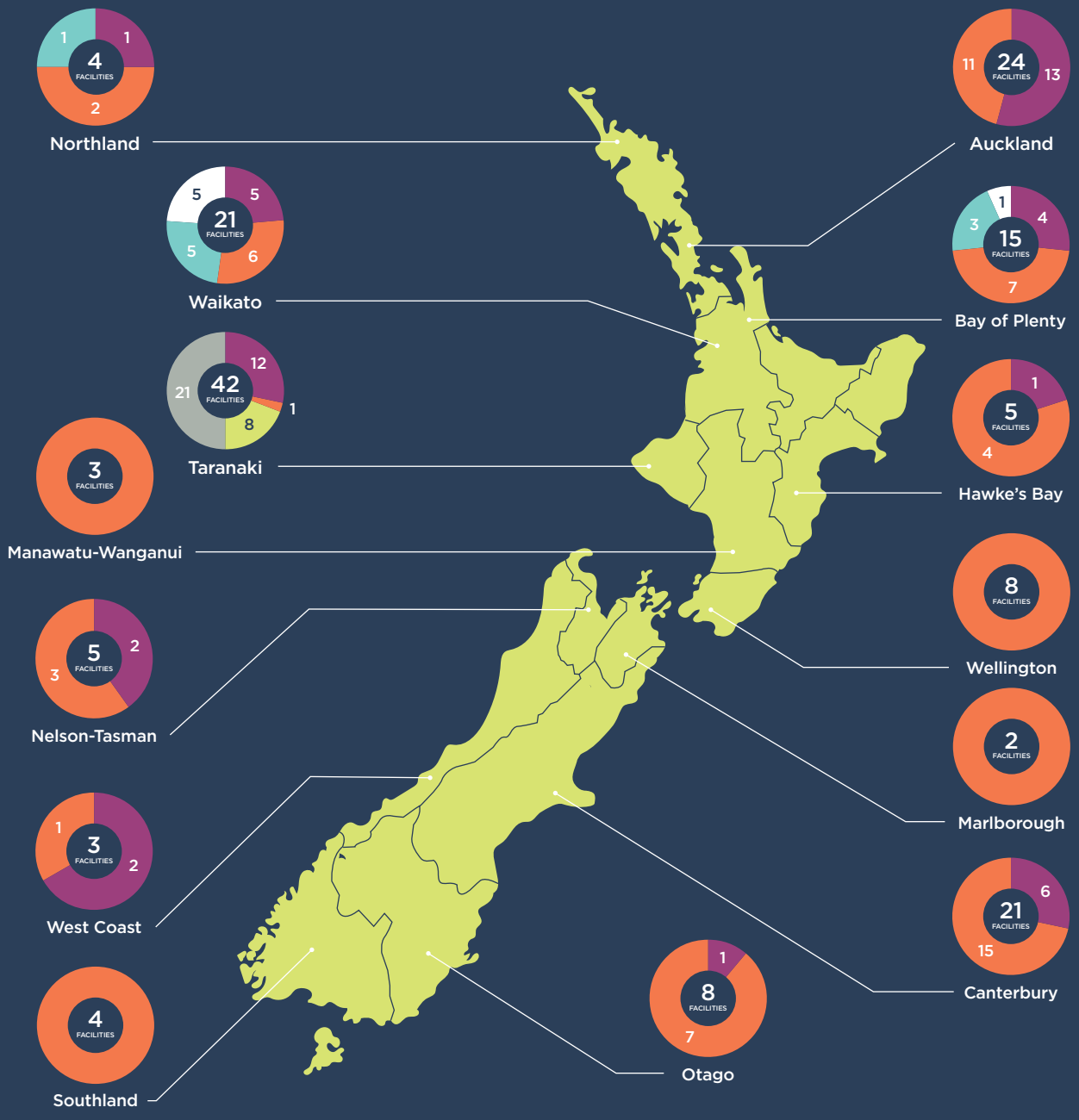


Our mission is to transform New Zealand's health and safety performance towards world-class. To achieve this requires the commitment not just of WorkSafe, but of businesses, workers and a wide range of other players in the health and safety system.

Overview of this report

Haere mai and welcome to our second annual report for Major Hazard Facilities, Petroleum and Geothermal industries. I would like to acknowledge the ongoing challenges and impacts of COVID-19 on your operations and workers.

The government response to COVID-19 continues to highlight how important worker health and wellbeing are to the success of our operations. For WorkSafe, we will be prioritising health-focused inspections in tandem with an ongoing focus on officer duties, upstream duties, and worker engagement, participation and representation. Businesses should ensure workers understand the environment they are working in, the risks and hazards they face and how they can contribute to the management of risks. WorkSafe want to highlight to PCBUs that a proactive worker voice can lead to significant improvements in culture, behaviour change and better health and safety outcomes for all. I encourage you to explore the SafePlus health and safety improvement toolkit developed jointly by WorkSafe and ACC. SafePlus enables in-depth conversations that include people at all levels of the organisation.

Last year, WorkSafe launched the #BetterWorkNZ programme and betterwork.nz website, which recognises the social and economic value of safe workplaces. New Zealand Inc, businesses, communities, and individuals rely on good quality work. Done well, work can lift people's quality of life, provide greater equity, create greater inclusion, empower marginalised groups, ensure that people come home from work healthy and safe, and drive inclusive economic growth and global competitiveness.

Across the high hazard industries, we received 279 incident notifications for petroleum, geothermal and MHF sites in the year to July 2021, a similar number to the previous year (289 incidents). There are still too many incidents occurring that had potentially major consequences with 13 requiring emergency response plans to be activated and 23 that had the potential to cause a major incident had any of the other controls failed. Included in this report is a selection of incidents that were notified to WorkSafe and a summary of the learnings from those incidents. We have increased our emphasis on the investigation of high potential incidents by establishing two High Hazard Specialist Investigator positions. These roles will also focus on identifying learnings from WorkSafe and PCBU investigations of incidents and sharing insights back to high hazard industries.

Over the past year we have actively targeted follow-up inspections to verify how PCBUs of upper tier sites are working to their agreed safety case. This report summarises our inspection and enforcement activity, and includes two case studies that demonstrate our regulatory approach and provide insight into how we work to engage with and educate the sector. From early 2022, we will be inspecting more MHF lower tier sites to provide regulatory assurance that high hazard risks are being managed at these sites.

We have several new initiatives for our high hazard industries, including:

- establishment of a hazardous industries inspection team that will have regulatory oversight of facilities that fall below the threshold for MHF designation
- an internal hydrogen working group
- an internal liquified petroleum gas (LPG) working group
- a regulatory review of MHF fees and levies

More information on each of these initiatives can be found in section 3.

I would like to take this opportunity to thank you all for your efforts and positive contributions to improving health and safety outcomes across the sector. We found it valuable meeting with you at the geothermal, petroleum and MHF forums. Our interactions told us you wanted more opportunities to meet outside of regulatory engagements, and to see more analysis of performance data we have captured highlighting areas you need to focus on. We will continue to work on meeting your needs. I look forward to welcoming you to our industry events in the year ahead.

Donna Ellis

Chief Inspector High Hazards

1 Major Hazard Facilities are designated as upper or lower tier from the quantity of specified hazardous substances present at a facility, as outlined in Schedule 2 of the Health and Safety at Work (Major Hazard Facilities) Regulations 2016, and the type of facility is determined by how the specified hazardous substances are used, as outlined in Schedule 8.

2 Petroleum Installations are designated as upper or lower tier from the quantity of petroleum produced and the amount of liquefied flammable gases at the installation, as outlined in section 3 (1) of the Health and Safety at Work (Petroleum Exploration and Extraction) Regulations 2016.

1.0 About the regulatory regime

The petroleum and MHF regulatory regimes were established in 2013 and 2016 respectively, with the introduction of the Health and Safety at Work (Petroleum Exploration and Extraction) Regulations 2016 ("the PEE regulations") and the Health and Safety at Work (Major Hazard Facilities) Regulations 2016 ("the MHF regulations") under the Health and Safety at Work Act 2015 ("the Act").

The Geothermal Energy Regulations 1961 ("the Geothermal Energy regulations") while still in effect are largely revoked, and for this reason geothermal activities are predominantly regulated under either the Act or the MHF regulations (binary plants are designated as MHFs).

At the heart of the regulatory regimes is the requirement for upper tier MHFs, upper tier petroleum production installations and non-production installations to have an accepted safety case in place. An accepted safety case is effectively a leading indicator that high hazard risks have been identified by the operator, and that processes are in place to ensure those risks are effectively managed. The integrity of the plant and structures involved in high hazard operations is fundamental to ensuring safety. Ensuring asset integrity is essential to safety, continued economic production and plant reliability. This often requires a close linkage between safety and the investment strategy of the business. Safety must be seen as an integral aspect of operating the business, it cannot be an after-thought or add-on.

Worker engagement is a key requirement of, and fundamental to the effectiveness of a safety case and the effective operation of complex plant. Both WorkSafe as the regulator and businesses need to engage effectively with workers. It's important to ensure that workers understand the instructions and training they are given about the operation of hazardous facilities and installations. Engaging with the workforce is also important because they know how work is done rather than how it is imagined by senior staff and management, and are therefore better able to identify suitable and effective controls. Effective engagement with the workforce is essential to ensure that workers are properly involved in developing work systems and that what needs to happen on site is actually being delivered in practice.

2.0
Review of the past year

2.1 Safety cases

As reported to you last year, upper tier MHFs are in their first five-year cycle of safety cases, with all existing facilities required to have an accepted safety case in place by April 2021. In working collaboratively with industry, WorkSafe was able to complete this process by August 2020, some eight months ahead of the legislated completion date. The High Hazard Specialist Inspectors and Deputy Chief Inspectors committed to a dedicated programme to work with industry to achieve this.

Petroleum installations are into their second five-year safety case cycle. In the past year, the High Hazards team at WorkSafe reviewed 12 revised Petroleum safety cases and one safety case for a Major Hazard Facility. All upper tier MHFs in NZ (including nine geothermal power stations with binary plant designated as MHFs) now have an accepted safety case, which is required for them to operate.

The numbers of safety cases accepted annually for Petroleum, MHF and Geothermal MHF sites since the beginning of the petroleum regime are shown in Figure 1.

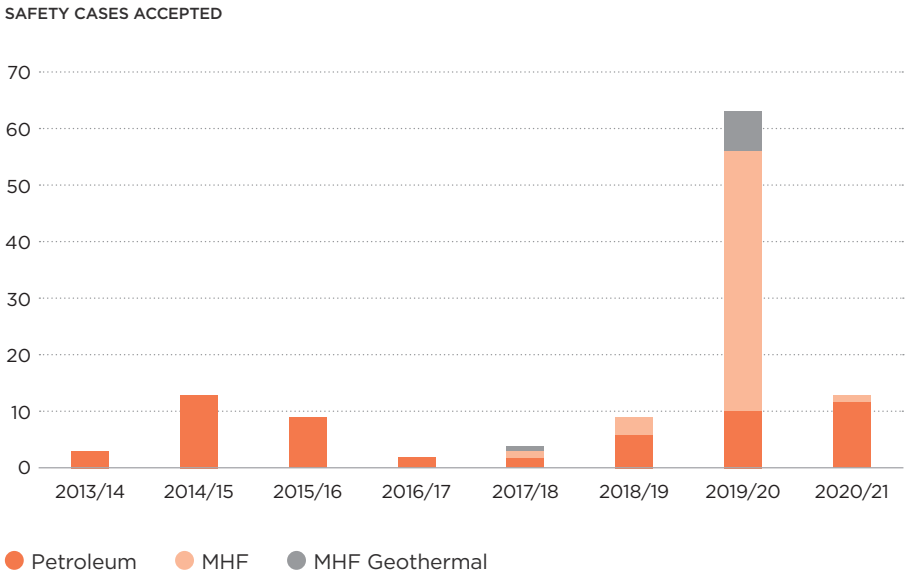


FIGURE 1: Safety cases accepted each year for Petroleum, MHF and Geothermal MHF sites

With all upper tier MHF sites now having an accepted safety case, the focus for inspectors this year shifted to the on-site verification that all elements of the safety case are actually in place on site and working effectively, and following up on future inspection topics identified in safety case assessments.

2.2 Site inspections

Sites are prioritised for inspection based on our assessment of the quality of the safety case, the number of future inspection topics, the time since the last inspection, and reported incidents or complaints. Last year, 109 high hazard site inspections were undertaken across a range of industries (Figure 2).

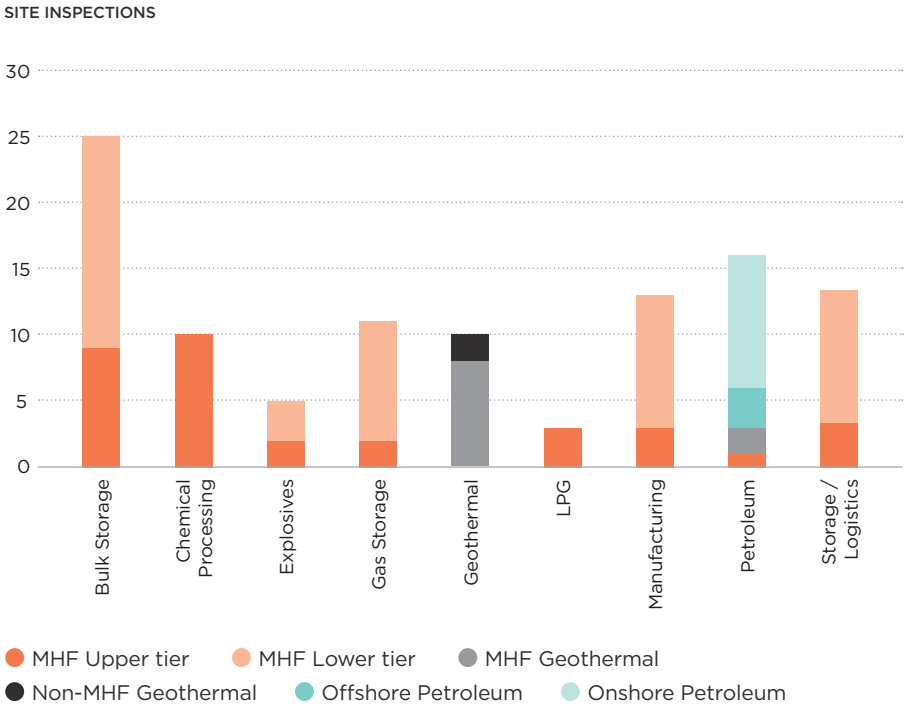


FIGURE 2: Site Inspections undertaken in 2020/21 by industry sector

2.3 Enforcement measures

Where inspectors identify health and safety issues, a range of enforcement measures are available for use. Enforcement measures include prohibition, improvement and non-disturbance notices, sustained compliance notices and directive letters. Recommendations may also be made but these are not legally enforceable. Inspectors are guided as to the appropriate level of enforcement by our Enforcement Decision-making Model (EDM).

Table 1 shows the number of enforcement measures taken in 2020/21 by enforcement and site type. Last year, 738 enforcement measures were taken at high hazard sites across a range of industries (Figure 3). The majority of the enforcement measures were taken at lower tier MHF (47%) and upper tier MHF (41%) sites.

Last year, 444 enforcement measures were complied with at high hazard sites (Table 2) – including enforcement measures issued in the 2020/21 financial year and prior. We will continue to focus on following up outstanding enforcement measures in 2021/22 to ensure they are complied with in a timely manner.

Site inspections in 2020/21 by high hazard site type

39
MHF Upper tier

47
MHF Lower tier

8
MHF Geothermal

2
Non-MHF Geothermal

3
Offshore Petroleum

10
Onshore Petroleum

ENFORCEMENT MEASURE	MHF UPPER TIER	MHF LOWER TIER	OFFSHORE PETROLEUM	ONSHORE PETROLEUM	MHF GEOTHERMAL
Prohibition Notice	2				
Improvement Notice	46	38	1	2	4
Sustained Compliance Letter		1			
Non-Disturbance Notice	28				
Directive Letter	171	233	8	16	18
Verbal Direction		1			
Recommendations	59	73	4	27	6

TABLE 1: Enforcement measures taken and recommendations made in 2020/21 by high hazard site type

ENFORCEMENT MEASURE	MHF UPPER TIER	MHF LOWER TIER	OFFSHORE PETROLEUM	ONSHORE PETROLEUM	MHF GEOTHERMAL
Improvement Notice	32	22	1	2	
Directive Letter	114	132	6	15	7
Recommendations	24	39	13	27	10

TABLE 2: Enforcement measures complied with in 2020/21 by high hazard site type

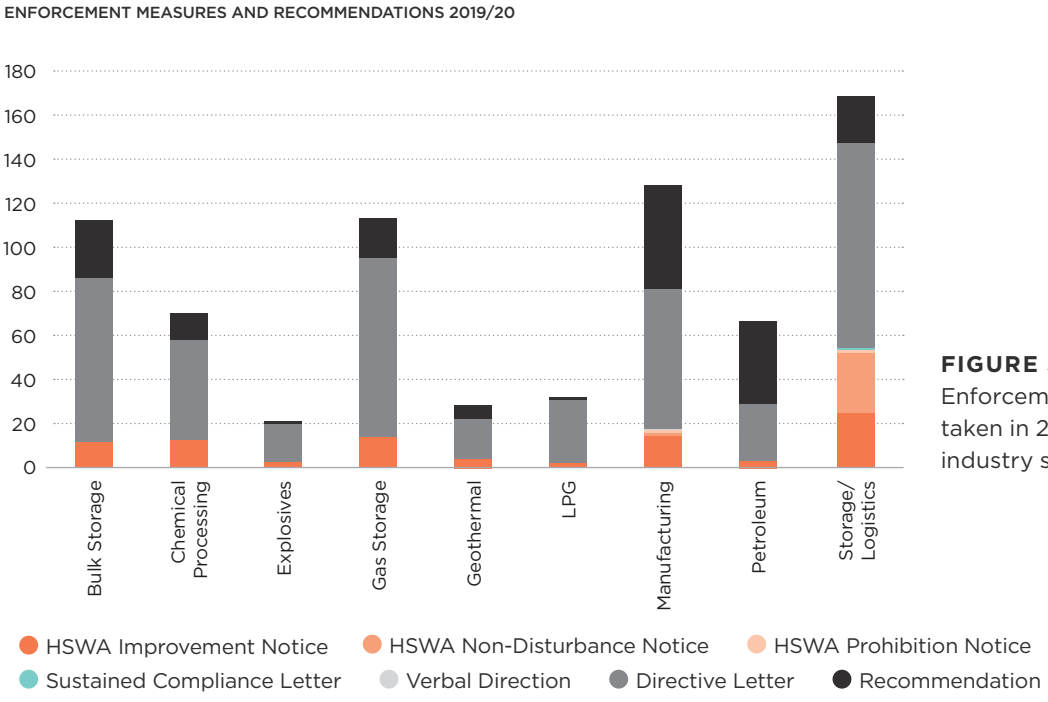


FIGURE 3: Enforcement measures taken in 2020/21 by industry sector

Figure 4 shows the number of enforcement measures issued in 2020/21 by category and provides an indication of the key areas of concern to our inspectors. Last year, the majority of enforcement measures were issued for health and safety issues relating to emergency response plans (18%), operational controls (17%), and safety assessments (16%).

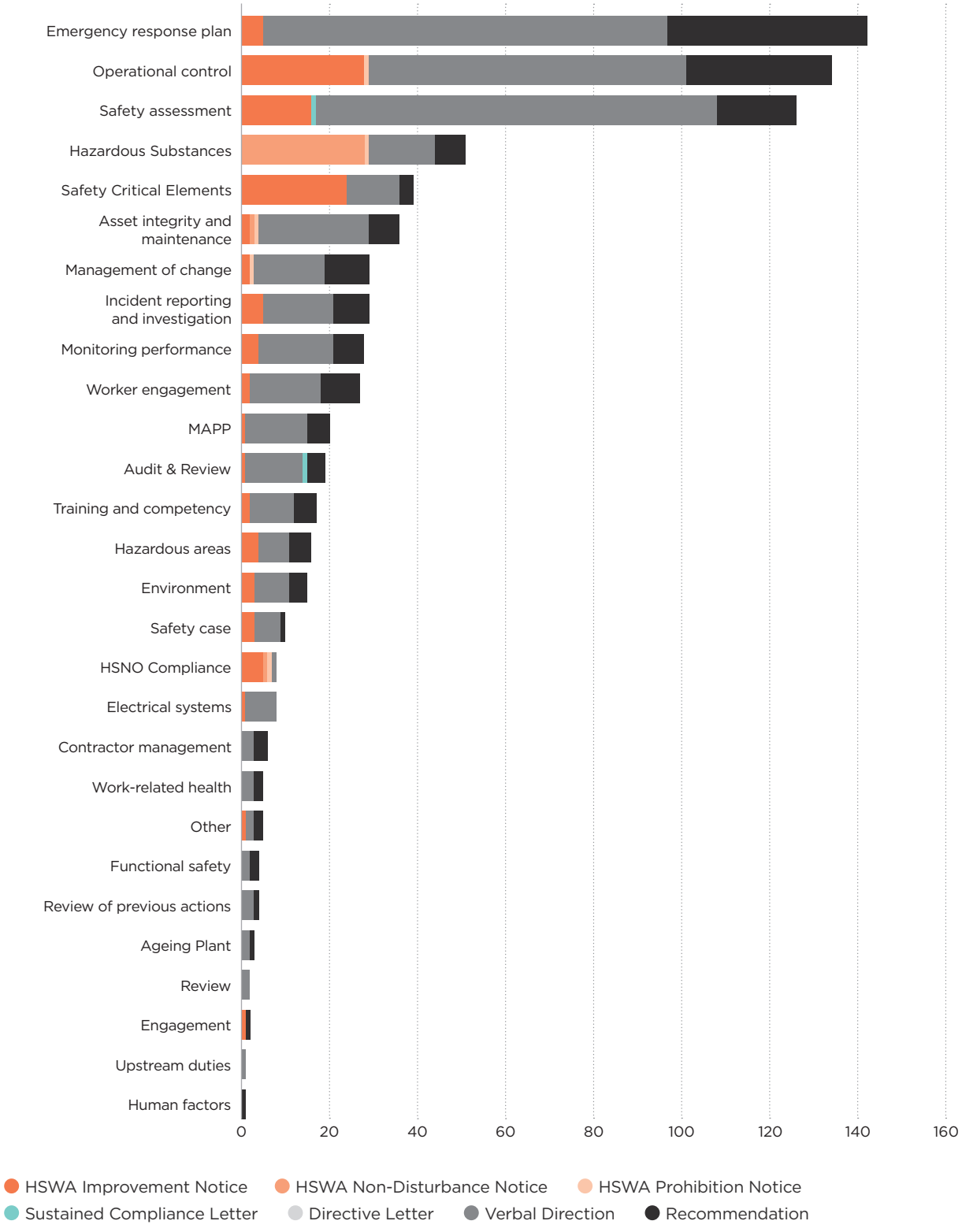


FIGURE 4: Enforcement measures taken in 2020/21 by category

Case study

Engagement driving better work at Fonterra

WorkSafe aims to make a measurable difference using our levers of engagement, education, and enforcement. These are powerful drivers for achieving a step change in health and safety performance. In the past year we worked with Fonterra NZ Ltd to deliver significant improvements to health and safety at their sites.

Fonterra has 28 sites throughout New Zealand, two of which are designated major hazard facilities. Through our inspections, several key risks were identified within their safety management system. WorkSafe issued a range of directives and notices to address these matters. Fonterra responded positively and identified good solutions in collaboration with WorkSafe inspectors. We used ongoing engagement and education to also help achieve the right outcomes for all.

WorkSafe engaged at multiple levels with Fonterra. Regular meetings between WorkSafe and Fonterra executives covered program and progress updates. Inspectors also engaged at senior, mid and worker levels to educate and monitor progress. Areas for improvement included: re-baselining the safety assessment with more depth; improving follow on emergency planning and preparedness; improving organisational wide management of change; seeking further hazardous substance compliance, and; establishment of safety critical element verification and assurance processes.

WorkSafe Chief Executive, Phil Parkes said that the engagement we have had with Fonterra is a model for how we should do interventions. General Manager, Global Critical Risk at Fonterra, Chuck Norris says every finding is a chance to learn and improve how we look after our people, communities, and the environment. “We are appreciative of our ongoing professional relationship with WorkSafe”.

To address many competing needs across a global food manufacturing and distribution business, a cross-functional team with improved process safety capabilities was established. This included key industry partnerships leveraging skills and capabilities from many places. Fonterra are now working through the ongoing deployment and improvement of a globally recognised 14 element Process Safety Management model. This seeks to standardise how reasonably foreseeable harm is continually sought out and prioritised for action. The solutions also seek to manage decisions across a competing priorities framework in all PCBU locations around New Zealand.

Throughout the ongoing engagement, we have seen additional examples of win-win solutions for safety and business. Fonterra didn’t limit their work to only the designated MHF. They continued to take the major hazard facilities lessons and implement principles of process safety across their entire manufacturing business. They have now started extending this work to Australia and further abroad, and see process safety as an organisational journey and not just a compliance destination. Fonterra has clearly elevated its process safety focus to be in line with its food safety and environmental custodianship.

2.4 Notifiable incidents

Notifiable incidents, known to high hazard industries as 'near-misses' or 'precursor events' must be reported to WorkSafe under section 24(1) of the Act, regulation 70 of the PEE regulations, regulation 33 of the MHF regulations, and regulation 35A of the Geothermal Energy regulations.

Figure 5 shows the number of notifiable incidents at high hazard sites between July 2017 and June 2021. The number of notifiable incidents reported has increased over time as expected, due to improved understanding by operators to notify as per their legislative requirements.

In the past 12 months (July 2020 – July 2021), 279 notifiable incidents were reported, slightly less than the 289 reported in the previous year. In the past 12 months, nearly half of MHFs (48%) and 71% of petroleum and non-MHF geothermal sites reported notifiable incidents. This is an improvement on last year of 15% for MHF.

Inspectors will review reporting arrangements as part of our inspection approach. It is essential that operators monitor their processes for notifiable incidents as these are important indicators of failures in risk management. Having identified and reported incidents, operators should also investigate the causes of the incident, and take action to rectify failures and prevent their reoccurrence. We will increase our emphasis on the investigation and insights from notified incidents in 2021, see page 26.

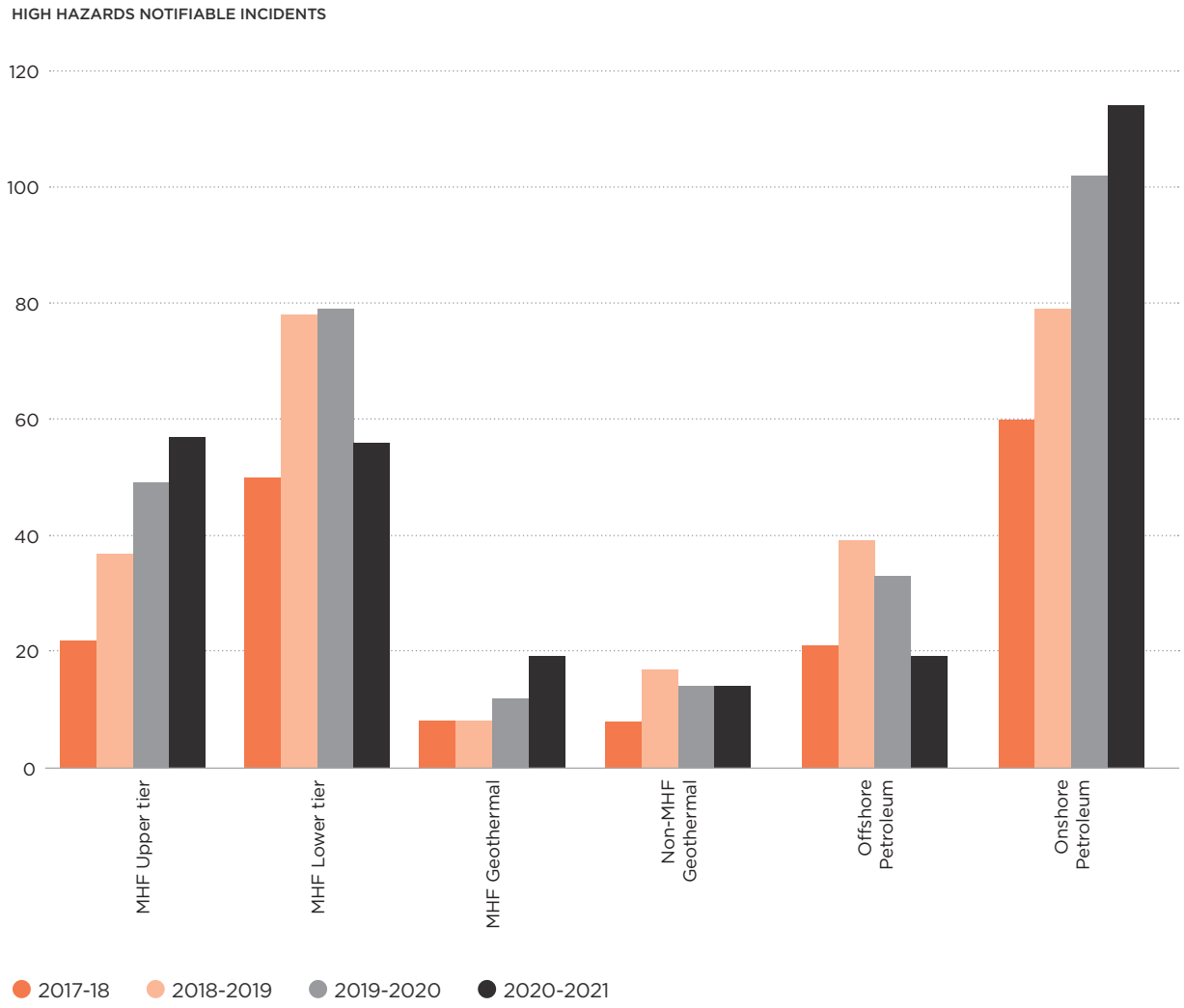


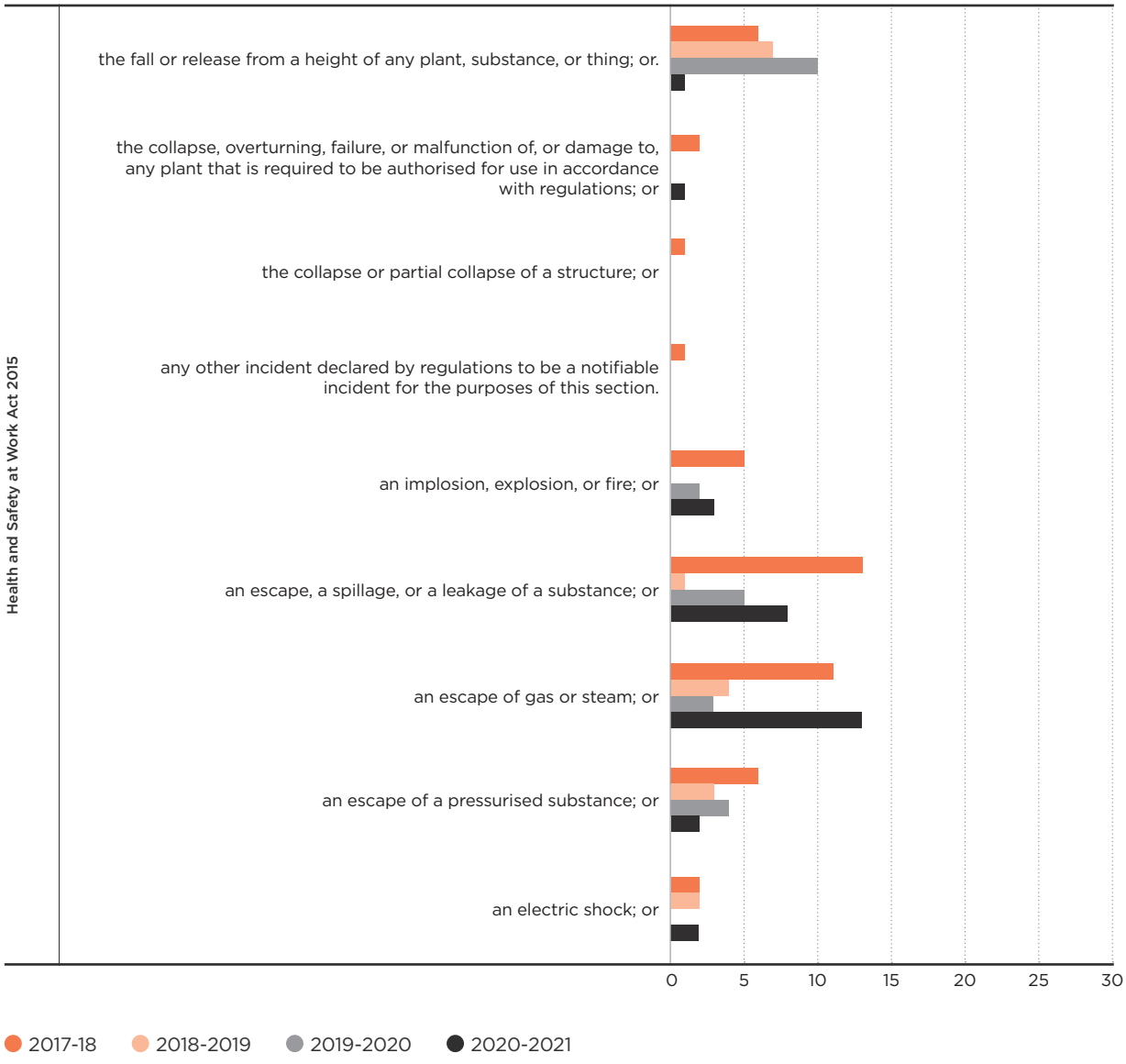
FIGURE 5: Notifiable incidents reported by high hazard site type between July 2017 and June 2021

Figures 6 and 7 show the legislative categories for notifiable incidents reported to WorkSafe for the four years between July 2017 and June 2021. The data shows that in the 2020-21 year, 68% of notifiable incidents involved damage to, or failure of, a safety-critical element that required intervention to ensure it will operate as designed, a decrease from 83% in 2019-20.

A total of 13 unplanned incidents (other than false alarms) requiring emergency plans to be implemented occurred and 23 incidents that did not cause, but had the potential to cause a major incident occurred.

There were three incidents involving an uncontrolled release of hydrocarbon vapour (exceeding 1kg) and two incidents involving an uncontrolled release of petroleum liquids (exceeding 80L). In different circumstances, any of these incidents could have given rise to a major incident.

LEGISLATIVE CATEGORIES FOR NOTIFIABLE INCIDENTS REPORTED BY HIGH HAZARD SITES BETWEEN JULY 2017 AND JUNE 2021 (EXCLUDES DAMAGE TO, OR FAILURE OF, A SAFETY-CRITICAL ELEMENT THAT REQUIRES INTERVENTION)



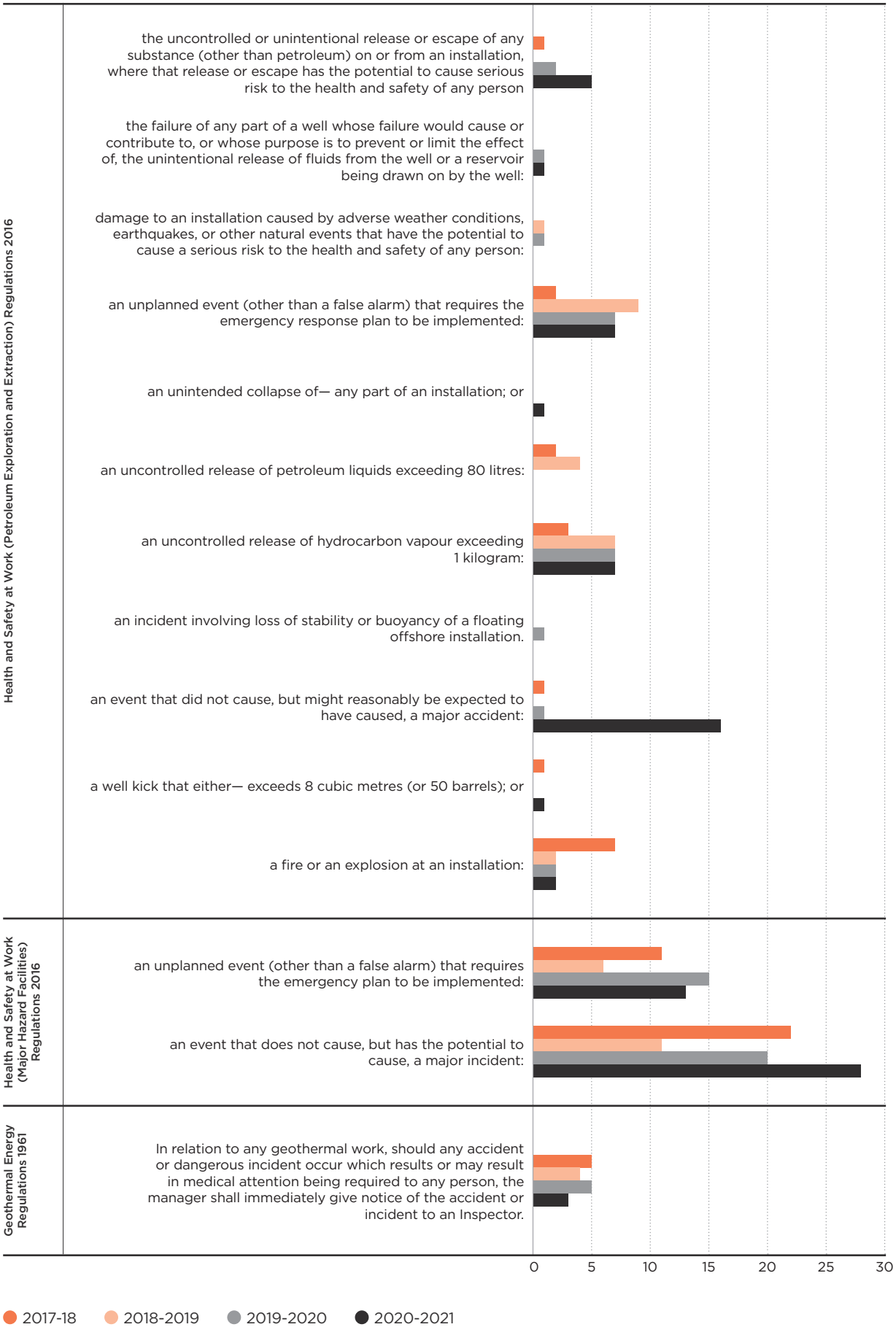


FIGURE 6: Legislative categories for notifiable incidents reported by high hazard sites between July 2017 and June 2021 (excludes damage to, or failure of, a safety-critical element that requires intervention)

LEGISLATIVE CATEGORIES FOR NOTIFIABLE INCIDENTS REPORTED BY HIGH HAZARD SITES BETWEEN JULY 2017 AND JUNE 2021 OF: DAMAGE TO, OR FAILURE OF, A SAFETY-CRITICAL ELEMENT THAT REQUIRES INTERVENTION TO ENSURE IT WILL OPERATE AS DESIGNED

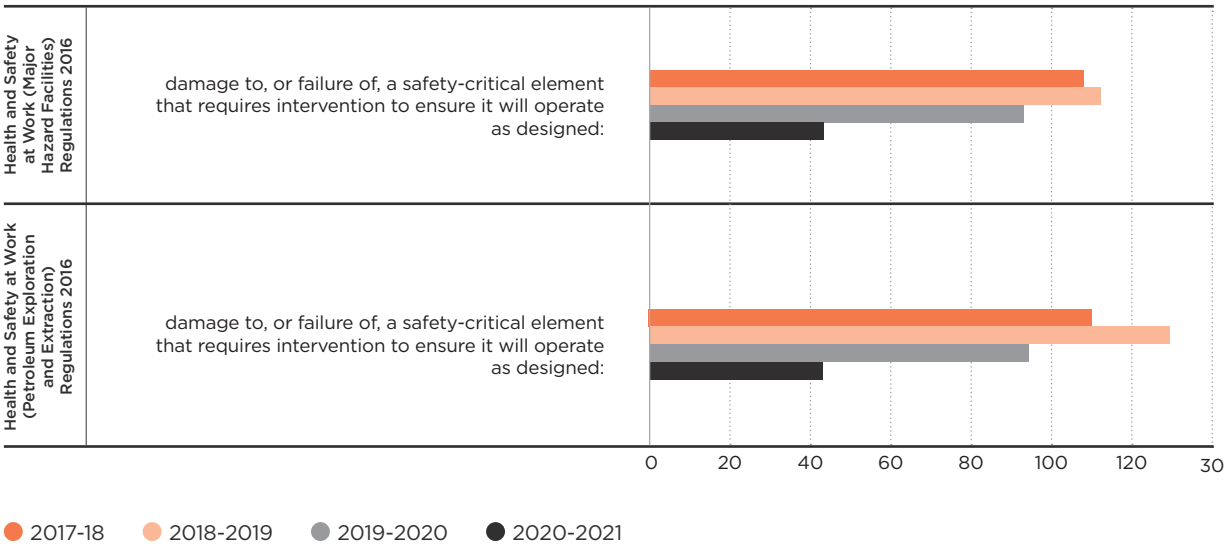


FIGURE 7: Legislative categories for notifiable incidents reported by high hazard sites between July 2017 and June 2021 of: damage to, or failure of, a safety-critical element that requires intervention to ensure it will operate as designed

Case study

Investigation into upstream duties

When WorkSafe launches an investigation, our focus is not solely on the those directly involved in an incident, but also those with upstream influence or duties, such as suppliers and importers. In 2020-2021 upstream duties were identified as a focus for WorkSafe.

What are upstream duties?

Businesses which design, manufacture, import and supply plant, substances and structures share a responsibility to minimise health and safety impacts on the workers who use the plant, substances and structures.

These upstream businesses in the supply chain have a duty to ensure, so far as is reasonably practicable, that the work they do or the things they provide to other workplaces do not create health and safety risks.

Upstream businesses are in a strong position to eliminate or minimise risk. They can influence and sometimes eliminate health and safety risks by designing or manufacturing products that are safe for the end user.

Upstream businesses should consider the potential health effects of products intended for use by downstream businesses and their workers, for example, a plant manufacturer should consider whether the noise level of its equipment could increase the risk of hearing loss.

- Upstream businesses have a duty to downstream businesses, workers and others.
- Importers must ensure imported goods meet all New Zealand regulatory requirements.

In December 2020, WorkSafe investigated a chlorine cylinder leak at a storage warehouse in Auckland. The incident was contained using specialist equipment provided by the chlorine importer and held on site by the operator. During the investigation, the operator of the major hazard facility was interviewed to determine the actions taken to manage the incident on the day. While it was generally well managed, some improvements were identified by both WorkSafe and the operator. It was a good opportunity to look at emergency procedures and training of those involved and how the operator interacts with emergency services.

The operator consulted and liaised closely with WorkSafe and the emergency services. The operator said that the investigation was a helpful and constructive exercise. The operator appreciated the response, support and openness from the WorkSafe inspectors. The operator knows they can now pick up the phone to an inspector for advice at any time.

The consultation and investigation process helped the operator to discuss safe operating procedures with third parties and their workers. While the incident was of low consequence, it had a potential for high consequence, which is now fully understood by workers at the facility. Following the incident with WorkSafe's support and expertise, the operator was able to effect some improvements in work instructions, procedures, wearing of personal protective equipment, worker training and interactions with emergency services.

In addition to interviewing the operator, WorkSafe looked at the upstream duties of importers and suppliers. The chlorine supplier is not a major hazard facility operator, but WorkSafe inspectors met with them. Again some improvements were identified and acted on, which included emergency planning, number and location of capping kits and response to incidents involving cylinders. The supplier said that they found the investigation process to be constructive. Both the operator and supplier involved in the investigation responded quickly to requests for information and were open in their dealings with WorkSafe.

Learning from Incidents

From Notifiable Incidents received by WorkSafe over the past year, a selection has been made for this report. Below is a summary of these incidents along with learning that operators may wish to consider where relevant to their organisation(s).

INCIDENT DATE	INDUSTRY	SUMMARY	CONSIDERATIONS
Aug 2020	Petroleum and Geothermal	A work party undertaking maintenance operations at a timber drying facility subsequently developed headaches, diarrhoea, and vomiting. The work party is thought to have been exposed to Hydrogen Sulphide (H2S) when they broke into the pipework associated with the supply of separated geothermal water (SGW). The facility is supplied SGW from which heat is extracted to dry timber. Also located on the site is an idle geothermal well and this is thought to be the source of the H2S. Under a previous management of change process, a bleed line from the idle well was connected directly into the drying facility's plant discharge line upstream of the discharge silencer to direct any gases from the well to vent. As this bleed line from the well was not isolated as part of the recent maintenance work, this allowed gas from the well to migrate back through the plant discharge line to where the maintenance workers had removed pipework.	– Management of change – consider how each change will affect the safe execution of all activities to be conducted on the site. Will the change introduce new hazards? – Fully consider and implement boundary isolations to prevent influx of hazardous fluids. – Conduct plant walkdowns to physically identify and confirm all required isolation points. – Risk assessments for maintenance activity need to include the potential impact from concurrent activities – Embed knowledge and understanding of symptoms and effects of toxic gas exposure and how to mitigate them.
Oct 2020	Major Hazard Facilities	During normal plant operations, a through-wall failure occurred in the shell of a secondary reformer vessel in an ammonia plant. The failure was due to hot process fluids breaching the refractory lining and impacting the steel shell of the reformer. This resulted in the release of process fluids to atmosphere at a height of approximately 5 metres. There was no ignition of the vapour, and the plant was shut down immediately.	– Conduct due diligence of design and installation procedures even when specialist contractors are engaged to conduct the work. – Maintain rigorous oversight and quality assurance of all plant refurbishment activities. – Conduct regular internal and external integrity inspections of process equipment.
Oct 2020	Major Hazard Facilities	Following modifications to alarms to indicate fire pumps running or faulted, the site team physically tested the alarms by running the pumps. During pump start up, throttles were incorrectly rotated unknowingly damaging the throttle cables. The pumps were run and then shut down, and the throttles were returned to the full speed position. Three days later a routine maintenance inspection included test running the fire pumps. The pumps were started with throttles in the idle position, however when the throttles were advanced to full speed the engines did not respond. With no control over engine speed and with the engines running at idle, the ability of the pumps to deliver the designed amount of fire water for tank cooling was significantly limited.	– Have visual guidance or physical limits for fire pump engine throttle positions. – Include OEM package equipment functionality in design and HAZOP processes. – Using the Permit to Work system, control all maintenance and testing work to be carried out on Safety Critical Elements (SCE). – As part of operations and maintenance planning, confirm the competence of those individuals assigned to complete specific tasks prior to the work being undertaken.

INCIDENT DATE	INDUSTRY	SUMMARY	CONSIDERATIONS
Nov 2020	Petroleum and Geothermal	During 7" casing running operations, the casing running tool impacted a joint of casing at height. The casing joint was at well centre with its base inside the Volant stabbing guide installed on the previous joint. The Push/Pull Unit (PPU) was lowered faster than expected and load was placed on the casing joint causing it to deform. As the PPU was lifted with the casing, the joint swung back towards well centre and dropped off the Volant tool falling vertically to the floor. Prior to the operation a Floor Hand had been standing on top of the Uni-tong through which the stump of casing protruded (as required by casing running procedures), however he had retreated to the green zone when he saw the casing deform.	– Have you considered all the risks associated with your casing running procedures? – Any misalignment of the rig from well centre may have an impact on safe operations. – Designation and enforcement of green (go) and red (no-go) zones protects personnel. – Competence, training, and equipment familiarity reduces risk to personnel and the operation. – The importance of being fit for work cannot be overstated especially when supervising personnel during high-risk activities. – Management of change – consider how each change will affect the safe execution of all activities to be conducted on the site. In this case the casing running procedure using the Volant casing running tool was utilised for the operation however required updates to address rig-specific aspects.
Nov 2020	Petroleum and Geothermal	A sample line off a condensate rundown header was opened to the wastewater sump to clear the line before routine sampling. This was then inadvertently left open for a period of 24 hours before being discovered and subsequently closed. The stabilised condensate accumulated and was contained in the wastewater drain system. Over the next week the condensate was removed incrementally from the wastewater drain system.	– Beware of the normalisation of risk. In this case the sample line from the header was prone to blockage which required the line to be flushed for a period before sample taking. – Localised practices can diverge from established formal procedures when workers must adapt to extended operational problems. – Focussed watch-keeping during filling, emptying, transferring, and draining hydrocarbons and other liquids is essential. – When developing or reviewing process procedures, consider human factors that may influence the performance of associated tasks. – Are there fail-safe mechanisms that can be implemented to remove or mitigate the human factor element?

INCIDENT DATE	INDUSTRY	SUMMARY	CONSIDERATIONS
Nov 2020	Petroleum and Geothermal	During steady production, a worker noticed white vapour leaking from a propane heat exchanger in a gas train. The site siren was activated for a general muster and the site emergency response plan was initiated. Gas detection in the area did not register the leak due to its location, the release volume, and the wind speed and direction at the time. The leak was subsequently found to be from a pinhole in one of the exchanger tubes.	– The observation and quick actions of the worker onsite mitigated the extent of the leak. – Timely raising of the alarm and initiation of ESD/EDP reduces risk to personnel and plant. – Hazardous area equipment certification and condition integrity mitigate risk of escalation. – A gas detection system may not always register a leak depending on individual detector locations and any wind effects. Operators should consider revisiting gas dispersion modelling and detector positioning if gas detection could be affected by adverse weather conditions. – In an environment located near the coast periodic cleaning of salt deposits from external tubes and structure extends the service life of the equipment but ultimately does not prevent corrosion. Regular inspection, corrosion monitoring, and remedial action is required. – When responding to an emergency, such as a hydrocarbon release, there may be a tendency for workers to investigate the scene prior to that scene being made safe. This is usually to gain information on the size and status of the problem. However, personnel remain at risk even if the plant has already been ESD'd as the inventory is still present in the plant. Only after the scene is made safe, for example by ESD and EDP thereby removing the hazardous substance, should personnel be permitted to access the scene.
Dec 2020	Petroleum and Geothermal	During a rig operation of pulling-out-of-hole drill pipe and associated bottom-hole assembly, a drill collar was broken out and held in the mousehole by the mousehole clamp. A lifting cap with wire sling was attached to the top of the drill collar so that it could be lifted out and racked back using the pipe handler crane. The mousehole centraliser remained in use (it should have been isolated for drill collars) and due to the geometry of the drill collar (spiral cut-outs along its length) the drill collar was misaligned and as such the clamp did not have a uniform holding force applied to the drill collar. As the lifting cap (with sling) was being attached by two rig workers, the drill collar slipped through the clamp falling further into the mousehole quickly pulling the lifting cap and sling with it. This could have resulted in serious injury to either or both rig workers if struck by the sling as it rapidly entered the mousehole.	– Use the Hierarchy of Controls when assessing hazards and determining the controls to be used, with priority given to elimination of the hazard where possible. Alternative methods for lifting and stowing drill collars were available at the time eg. laying down as opposed to racking back. – Periodically review procedures to ensure that all risks are adequately identified and controlled. Are there any safer methods to achieve the same outcome? – Designation and enforcement of green (go) and red (no-go) zones protects personnel. – Being aware and positioning one-self out of the line-of-fire protects individuals from sudden movement of equipment or failure of components. – All equipment has limitations and these need to be known and understood by those personnel using the equipment.

INCIDENT DATE	INDUSTRY	SUMMARY	CONSIDERATIONS
Dec 2020	Major Hazard Facilities	Workers were to remove 960kg chlorine cylinders from a chlorine storage container as part of a customer order. Access to these cylinders was blocked by two steel stillages each containing ten 75kg chlorine cylinders and as such these needed to be removed first from the container. The workers noticed that one of the 75kg cylinders showed some discolouration on the side of the cylinder running from the neck to the base indicating that the cylinder likely had a small chlorine leak. A handheld gas detector was used and close to the cylinder valve protection cap it was confirmed that indeed there was a small leak. The open-yard concentration as tested by the workers (at >1m from cylinder) was well below workplace exposure standard limits and the workers continued with their work. The stillages were segregated by the workers inside an adjacent storage container and site management were informed. It was then decided to initiate a site evacuation and inform neighbouring facilities. A full site evacuation was completed once FENZ attended the scene, and they then capped the leaking cylinder with a capping kit provided by the operator.	– Holding appropriately sized cylinder capping kits onsite leads to a quicker isolation response for any cylinders found with leaks. Training for those who would apply the capping kits is essential. – Chlorine Institute Pamphlet 63, Table 2.1 Chlorine Exposure Thresholds, Limits, and Guidelines (ppm) - 0.2 – 0.4 Odour threshold (decrease in odour perception occurs over time) - Less than 0.5. No known acute or chronic effect - 20 AIHA ERPG-3: The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects. – The Chlorine Institute recommends a medical surveillance program, which would include baseline and periodic examinations, for personnel working in chlorine production, use, or handling facilities who are potentially exposed to chlorine, at or above the ACGIH® guideline of 0.5 ppm TWA or 1 ppm STEL during normal operations.
Feb 2021	Major Hazard Facilities	A release of an estimated 130 – 365 kg of ammonia occurred from a chiller system via an ammonia suction separator pressure safety valve (PSV). The release occurred while the chiller system was shut down as a part of a maintenance programme which was underway at the plant. Due to inadvertent gradual heating from a running chiller glycol pump transferring heat to the associated ammonia system, pressure in the ammonia suction separator rose above the set pressure of the PSV, causing it to relieve. The ammonia release, and its source, were identified by plant operators who activated the site emergency plan. The event was responded to by the local site emergency response team and mitigated by water fogging. The community fire response unit also attended the scene. There were no injuries because of this incident.	– The operation of the integrated dioxide plant (IDP) chiller was not well understood by site personnel, as maintenance for this equipment is normally outsourced. – There was a mismatch between the facility SOP and the OEM Operating Manual for chiller shutdown. – Guidance for responding to abnormal chiller conditions was insufficient. – Risks and controls relating to the ammonia chiller were not well understood or documented. – There was a failure to adequately implement improvements from a previous similar event. – At the time of installation of the IDP chiller, which uses ammonia, the Process Safety framework and Management of Change process were not sufficient to ensure that the risks associated with introducing a toxic chemical to the IDP plant were properly assessed and managed.

INCIDENT DATE	INDUSTRY	SUMMARY	CONSIDERATIONS
Feb 2021	Petroleum and Geothermal	An oil export pump suffered a mechanical seal failure resulting in a loss of containment of approximately 20 litres of crude oil. When the seal failed the oil sprayed out and around the tank bund. The pump is located within the bund and all associated electrical equipment is certified. A nearby operator stopped and isolated the pump immediately.	– The observation and quick actions of the onsite operator mitigated the extent of the leak. – Hazardous area equipment certification and condition integrity mitigate risk of escalation. – Effective secondary containment mitigates the consequences of a leak. – Early identification and treatment of produced sand mitigates the risk of process failures occurring.
Feb 2021	Major Hazard Facilities	Flexible Intermediate Bulk Container (FIBC) bags of ammonium nitrate were being de-vanned from ISO containers at a transitional shed facility. When the container was opened one bag was found to have shifted in transit. The bag was slung and lifted as per the handling procedure however as it was moved forwards it caught on the locking plate of one of the container doors. This created a tear in the wall of the bag and approximately 100kg of ammonium nitrate spilled onto the floor.	– FIBCs will likely come with clear manufacturer's recommendations for weight limits and general use. – Stack FIBCs only when you know their design permits safe stacking. Otherwise, they may present spillage or safety hazards. – FIBCs to be transported in containers need to be stacked correctly and properly secured within the container to prevent movement during transport and container handling. – Use all loops on the FIBC when lifting to ensure structural integrity and stability.
Feb 2021	Major Hazard Facilities	A loss of containment event occurred from an underground storage tank releasing approximately 5000kg of methyl methacrylate monomer (MMA) some of which migrated to the underground stormwater system. The first loss of containment occurred due to a mechanical failure of the tank shell weld after the tank was returned to service following maintenance work. Leaked fluids migrated to a broken underground stormwater pipe that bypassed the tank's secondary containment and site stormwater system. Artesian water flowing through the underground stormwater system diluted and carried MMA to an open creek which flows into a nearby harbour. The MMA impacted eels inhabiting the creek. The Operator was alerted of the event by FENZ who were attending the site in response to complaints of odour in the area. Onsite investigation quickly found the source of the release and the tank was pumped out and taken out of service.	– The tank involved, along with an internal repair to plug a redundant discharge pipe, had been inspected, leaked tested, and approved for use by a third-party tank tester in the months prior to this loss of containment event. – Strategically positioned groundwater monitoring wells may assist with identification and monitoring of underground releases and transient fluids. – Knowledge of the position and state of all underground services in an area of interest supports a comprehensive risk assessment. – Timely and effective emergency response mitigates consequences.

INCIDENT DATE	INDUSTRY	SUMMARY	CONSIDERATIONS
Feb 2021	Major Hazard Facilities	In preparation for a shutdown, operators were conducting gas oil flushing of a fractionation column. The associated top refluxes were not utilised due to a perceived shortage of gas oil. As a result, excessive hot vapour from the column carried over and condensed in the ejector overheads system leading to a significant amount of liquid in the system that the pump and drain systems could not adequately deal with. Ultimately hydrocarbon liquids were ejected from the high point vent and in falling onto hot parts of the plant below then ignited. The resulting fire was extinguished by the operators onsite.	– Detailed shutdown activity and materials planning along with effective communication between all parties involved is vital for the success of the activity. – The design and placement of high point vents needs to consider all potential events and associated consequences. – Regular condition monitoring and maintenance of hydrocarbon vessels and drains is required for technical and operational integrity. – Established site emergency response procedures need to be followed to mitigate risk to personnel.
Apr 2021	Petroleum and Geothermal	During drilling operations, a steel bracket weighing 730 grams fell approximately 6 metres from the top drive compensator system landing on the drill floor. At the time this area was not occupied due to the nature of the activity being undertaken however the drill floor is accessed by personnel during other activities. It was later found that two 6mm bolts were originally used to secure the bracket, and on review this is considered insufficient considering the application and location of the bracket.	– During rig inspection and acceptance activity, critically assess the appropriateness of fasteners for their intended purpose and service, even those fasteners that are OEM. – Implement and maintain a detailed Dropped Object prevention programme. – Install secondary retention to objects at height where possible. – Designation and enforcement of green (go) and red (no-go) zones protects personnel.

TABLE 3: A summary of incidents along with learning that operators may wish to consider where relevant to their organisation(s)

3.0 Our focus for the year ahead

3.1 Inspections

We plan to inspect every high hazard site at least once every two years. This year, we expect to undertake at least 100 inspections. At each inspection, we will ensure that we engage with the most senior person on site to explain the purpose of our visit and before we leave, we will discuss our findings, planned actions and secure their commitment to ensuring necessary improvements are made. Our formal correspondence will include senior personnel from the organisation and may include the organisation's Chief Executive Officer, General Managers, Country Manager, and Directors.

Our site inspections at sites with an accepted safety case in place will focus on verifying the topics identified for inspection during the safety case assessment. We will also assess topics and enforcement actions identified through previous site inspections to ensure they are now working effectively. We will also consider inspections as part of a notifiable event review.

3.2 Investigation and analysis of notifiable incidents

This year, we established two new Specialist Investigator positions in our High Hazards Team. These dedicated positions will focus on ensuring that complex process-safety incidents and precursor events are adequately investigated and analysed, and that industry has effective mechanisms in place to learn from precursor events.

The investigators will also systematically evaluate the rich source of data contained in the investigation reports submitted to WorkSafe by high hazard operators, and undertake cross-industry analysis of the nature of failings and their underlying causes.

We will use the learnings from the investigation and analysis of precursor events to inform our activities as a regulator, and educate high hazards industries to drive improvements in process safety across the sector.

3.3 Major incidents and emergency plans

In the event of a major incident, operators of a major hazard facility have a duty to provide the local community with information about the major incident. This duty has logistical problems for an operator who has to consider neighbours in a 1 km radius. Consequently, WorkSafe has investigated the use of the mobile phone emergency management alert (EMA) system as a way to help operators partially fulfil this duty.

WorkSafe has held discussions with the National Emergency Management Agency (NEMA), as lead agency for the EMA system, and also Fire and Emergency New Zealand (FENZ) as an authorised user of the system. It has been agreed that the use of the EMA system may be appropriate for particular circumstances during a major incident event.

In the coming year it is WorkSafe's intention to provide guidance to operators on how the EMA system can be used to assist in fulfilling this duty.

3.4 Approach to high hazard sites below the threshold for 'Major Hazard Facility' designation

We have now established a new Hazardous Industries team that will focus their regulatory activity at sites with hazardous substances quantities below the threshold to fall within the Major Hazard Facilities regime. These sites still have significant risks to manage in relation to hazardous substances. The new

team is currently developing their strategic programme of work and will begin undertaking inspections in the second half of this financial year. The team will also link in with the work of compliance certifiers and ensure that site standards are implemented and maintained.

3.5 Emerging technology – Hydrogen as a Fuel

We are running a programme of work that will contribute to the commercialisation of this emerging technology by helping to remove or work around any unnecessary regulatory barriers and ensure that the risks associated with the production, storage, handling, transport, supply and use of hydrogen are effectively managed. This initiative will also ensure that interested external parties innovating in this space will be well-connected with WorkSafe and set up for success.

3.6 Expectations for LPG Facilities

There are 26 MHF LPG sites, six of which are upper tier.

Of these, 13 were inspected in the 2020/21 financial year, and 12 have planned inspections in 2021/22.

There will be increasing focus on standardisation across the LPG industry, predominantly based on learnings from the safety management systems established at the upper tier facilities. These learnings have included:

- Major incidents and major incident hazards
- Consequence modelling & relationship with emergency plan
- Safety assessments that are a documented, comprehensive, and systematic investigation and analysis of all health and safety risks associated with major incident hazards.

Working alongside industry will be a crucial part of this process - WorkSafe will liaise and communicate with industry & the LPGA throughout.

The focus will be on increasing process safety knowledge and skills across the lower tier major hazard facilities, with the expectation that industry will learn from each other.

There are other MHF facilities handling LPG and learnings from the standardisation project will be cascaded down to those facilities as well.

3.7 Influencing land-use planning with territorial authorities

The Major Hazard Facilities team identified and met with five Territorial Authorities for a discussion on land use planning effects where councils have granted non-notified resource consents to PCBUs not conducting relevant offsite consequence modelling for high hazard sites in and around urban areas.

These engagements were to raise awareness of the increased risk associated with major incident hazards and potentially incompatible land use. In February 2021 the government announced it's intention to repeal the Resource Management Act 1991, which is the principal piece of legislation for land use planning matters. WorkSafe intend to monitor developments in this space, however it is strongly recommended that operators of high hazard industries also continue to monitor and be actively involved in land use planning decisions and legislative changes. Such decisions could increase the risk or the consequences of a major incident occurring at high hazard facilities.

3.8 Review of MHF Fees and Levies

Over the past 12 months WorkSafe has reviewed the funding and operating expenditure of its MHF function to understand how fair and equitable the cost recovery model is for industry, and to ensure that WorkSafe remains appropriately funded to undertake its regulatory function. This work will inform the regulated fee and levy review. The next steps will be to prepare future funding options and, following cabinet approval, consult with industry on any proposed changes.

3.9 International Regulatory Engagement

WorkSafe is an active contributing member of the International Regulators' Forum (IRF) for Global Offshore Safety. This group of international regulators is made up of representatives from New Zealand, Australia, UK, USA, Mexico, Canada, Brazil, Norway and Denmark. We meet twice annually and I encourage you to check out the IRF website at Health, Safety Regulatory For Oil and Gas Industry to view the range of information relevant to high hazard industries.

The IRF and industry identified three problem statements to be addressed collaboratively with the internationally recognised industry associations of International Association of Drilling Contractors (IADC) and International Association of Oil &Gas Producers (IOGP). You will find more information on these problem statements on the IRF website, with regular updates published. You are welcome to contact us to discuss these further.

In addition, the IRF publishes monthly articles which you are welcome to view on the IRF website at Monthly Articles | Safety Regulations for Oil, Gas.

The articles for 2019 and 2020 are listed in Table 5. These articles apply to any high hazard industry.

IRF AND INDUSTRY HAVE PREPARED THE FOLLOWING 3 PROBLEM STATEMENTS TO BE ADDRESSED COLLABORATIVELY

Prevention of well control incidents	Investigation quality/sharing & application of learnings	Digitalisation
Greater emphasis on "left hand side" of well control bow-tie, particularly with regards to PPFG prediction and monitoring	Improve investigation quality and improve ways to embed learnings	Reducing risks from automated systems with a human-centered design approach
IRF contact: NOPSEMA (Australia)	IRF contact: ANP (Brazil)	IRF contact: PSA (Norway)

TABLE 4:
Which problems are being tackled

SUBJECT	COUNTRY	PUBLICATION DATE
Operation Integrity	UK	July 2019
Management of Change	Canada	August 2019
Identifying and Addressing Risk	Australia / Brazil	September 2019
Regulator: Guard Dog and Guide Dog	Norway	October 2019
Functional Safety	New Zealand	November 2019
Supervision	Ireland	December 2019
Psychological Working Environment	Denmark	January 2019
Well Plugging & Abandonment	Netherlands	February 2019
Technology Development	USA	March 2019
Blow-Out Lessons Learned	UK	April 2019
Well Control	Australia	May 2019
Human Reliability	Brazil	June 2019
Digitalisation	Norway	July 2019
Collaboration Across Borders in Times of Crisis	Australia	August 2019
Never Another Major Incident	Norway	September 2019

TABLE 5:
Summary of IRF Articles (2019–2020)

3.10 Feedback

We are keen to know what you think and how we can provide better or more useful data next time. Please send any feedback to hhu.mhf@worksafe.govt.nz

Notes

Disclaimer

WorkSafe New Zealand has made every effort to ensure the information contained in this publication is reliable, but makes no guarantee of its completeness.

It should not be used as a substitute for legislation or legal advice. WorkSafe is not responsible for the results of any action taken on the basis of information in this document, or for any errors or omissions.

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